US011363101B2

(12) **United States Patent**
Asonye et al.

(10) **Patent No.: US 11,363,101 B2**
(45) **Date of Patent: Jun. 14, 2022**

(54) **USING EXISTING SERVERS IN A WELLBORE ENVIRONMENT AS DATA SOURCES FOR STREAMING SERVERS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/954,621**

(22) PCT Filed: **Mar. 8, 2018**

(86) PCT No.: **PCT/US2018/021617**
§ 371 (c)(1),
(2) Date: **Jun. 17, 2020**

(87) PCT Pub. No.: **WO2019/172917**
PCT Pub. Date: **Sep. 12, 2019**

(65) **Prior Publication Data**

US 2020/0382600 A1 Dec. 3, 2020

(51) **Int. Cl.**
H04L 67/12 (2022.01)
G06F 16/2455 (2019.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H04L 67/12*** (2013.01); ***E21B 41/00*** (2013.01); ***G06F 9/547*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC H04L 67/12; H04L 67/40; H04L 67/42; H04L 67/02; H04L 69/08; H04L 69/26;
(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,659,685 A 8/1997 Williams et al.
5,682,534 A 10/1997 Kapoor et al.
(Continued)

FOREIGN PATENT DOCUMENTS

EP 1494417 1/2005
GB 2456232 7/2009
(Continued)

OTHER PUBLICATIONS

McKenzie et al, A New Communication Protocol for Real-Time Decision Making, Sep. 6, 2016, Society of Petroleum Engineers Intelligent Energy International Conference and Exhibition, SPE-181088-MS (Year: 2016).*
(Continued)

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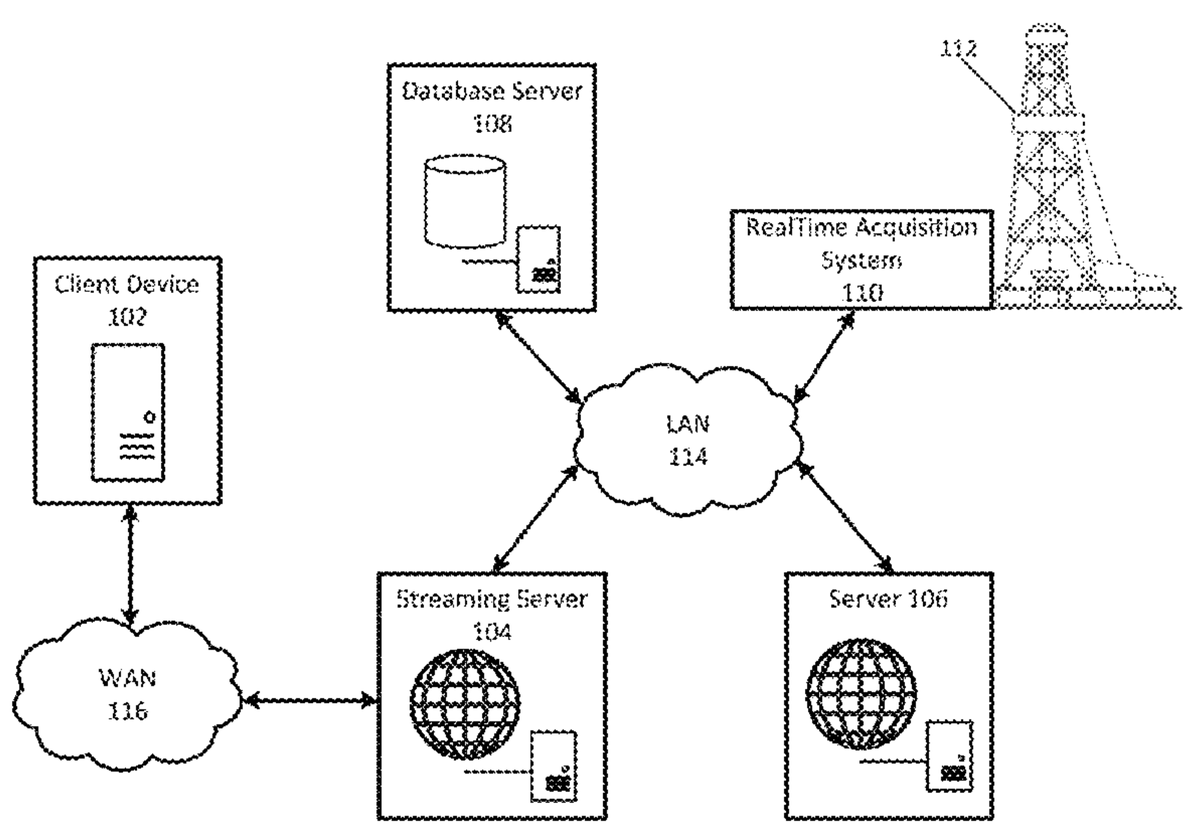
(57) **ABSTRACT**

A streaming server can receive a request from a client device to access data about a wellbore environment in a database server. The database server can be communicatively coupled to a server, which can be communicatively coupled to the streaming server. The streaming server can communicate data in a standardized format with the server using a request and response protocol. The streaming server can communicate the wellbore environment data from the database server in a streaming format with the client device.

20 Claims, 6 Drawing Sheets



(51) **Int. Cl.**

G06F 16/25	(2019.01)
E21B 41/00	(2006.01)
G06F 9/54	(2006.01)
H04L 67/02	(2022.01)
H04L 67/133	(2022.01)
H04L 67/01	(2022.01)
H04L 69/08	(2022.01)
H04L 69/00	(2022.01)

(52) **U.S. Cl.**
CPC ***G06F 16/24568*** (2019.01); ***G06F 16/258*** (2019.01); ***H04L 67/02*** (2013.01); ***H04L 67/40*** (2013.01); ***H04L 67/42*** (2013.01); ***H04L 69/08*** (2013.01); ***H04L 69/26*** (2013.01)

(58) **Field of Classification Search**
CPC .. G06F 16/24568; G06F 16/258; G06F 9/547; E21B 41/00
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,953,340	A	9/1999	Scott et al.	
6,519,568	B1	2/2003	Harvey et al.	
7,519,601	B2	4/2009	Dittmar	
7,546,613	B2	6/2009	Ikeda et al.	
8,121,971	B2	2/2012	Edwards et al.	
8,356,100	B2	1/2013	Zhu et al.	
8,429,288	B2	4/2013	Wang	
8,862,760	B1	10/2014	Fox	
8,892,891	B1	11/2014	Audebert et al.	
9,074,468	B1 *	7/2015	Selman	E21B 47/13
9,197,913	B2	11/2015	Pedlow et al.	
9,361,303	B2	6/2016	Tait et al.	
10,590,761	B1 *	3/2020	Bermudez Martinez	E21B 47/26
2004/0225724	A1	11/2004	Pavlik et al.	
2007/0047279	A1 *	3/2007	Evans	G06F 9/541 365/1
2009/0132458	A1 *	5/2009	Edwards	G06N 5/025 702/9
2009/0182472	A1 *	7/2009	Singh	E21B 47/12 701/50
2010/0235101	A1 *	9/2010	Aamodt	E21B 44/00 702/9
2012/0274664	A1 *	11/2012	Fagnou	G06F 3/04855 345/173
2013/0083031	A1 *	4/2013	Lehnherr	G06Q 10/06 345/440
2013/0254416	A1 *	9/2013	Abraham	H04L 29/08756 709/230
2014/0070956	A1 *	3/2014	Winkler	E21B 44/00 340/870.01
2014/0083688	A1 *	3/2014	Rojas	E21B 44/00 340/853.2
2014/0156806	A1 *	6/2014	Karpistsenko	G06Q 50/28 709/219
2015/0089021	A1 *	3/2015	Bergbauer	H04L 67/1097 709/217
2016/0053605	A1 *	2/2016	Abbassian	G05B 15/02 702/6
2017/0034311	A1	2/2017	Govind et al.	
2017/0342808	A1 *	11/2017	Dykstra	E21B 41/00
2017/0352169	A1 *	12/2017	Flanagan	G06T 11/206
2018/0171774	A1 *	6/2018	Ringer	E21B 47/024
2018/0298746	A1 *	10/2018	Short	E21B 41/00
2019/0170898	A1 *	6/2019	Contreras Otalvora	E21B 47/00
2019/0347590	A1 *	11/2019	Rajasekaran	G06Q 10/0635

FOREIGN PATENT DOCUMENTS

WO	2007092384	8/2007
WO	2017070025	4/2017

OTHER PUBLICATIONS

"WITSML Overview Guide", Energistics Energy Standard, Mar. 18, 2016, 23 pages.
International Application No. PCT/US2018/021617, "International Search Report and Written Opinion", dated Nov. 27, 2018, 12 pages.
"ETP v1.1 for WITSML v1.4.1.1 Implementation Specification", Energistics, Available Online at: https://www.energistics.org/wp-content/uploads/2018/01/ETP_v1.1_for_WITSML_v1411_Imp_Spec_v1.0_Doc_v1.0.pdf, Oct. 2017, 24 pages.
"WITSML V2.0 Release Candidate Overview Webinar", Energistics Organization, Available Online at: https://www.youtube.com/watch?v=ptb501-KoUg, Jul. 2016, 17 pages.
GB Application No. GB2011520.0 , "First Examination Report", dated Feb. 21, 2022, 3 pages.

* cited by examiner

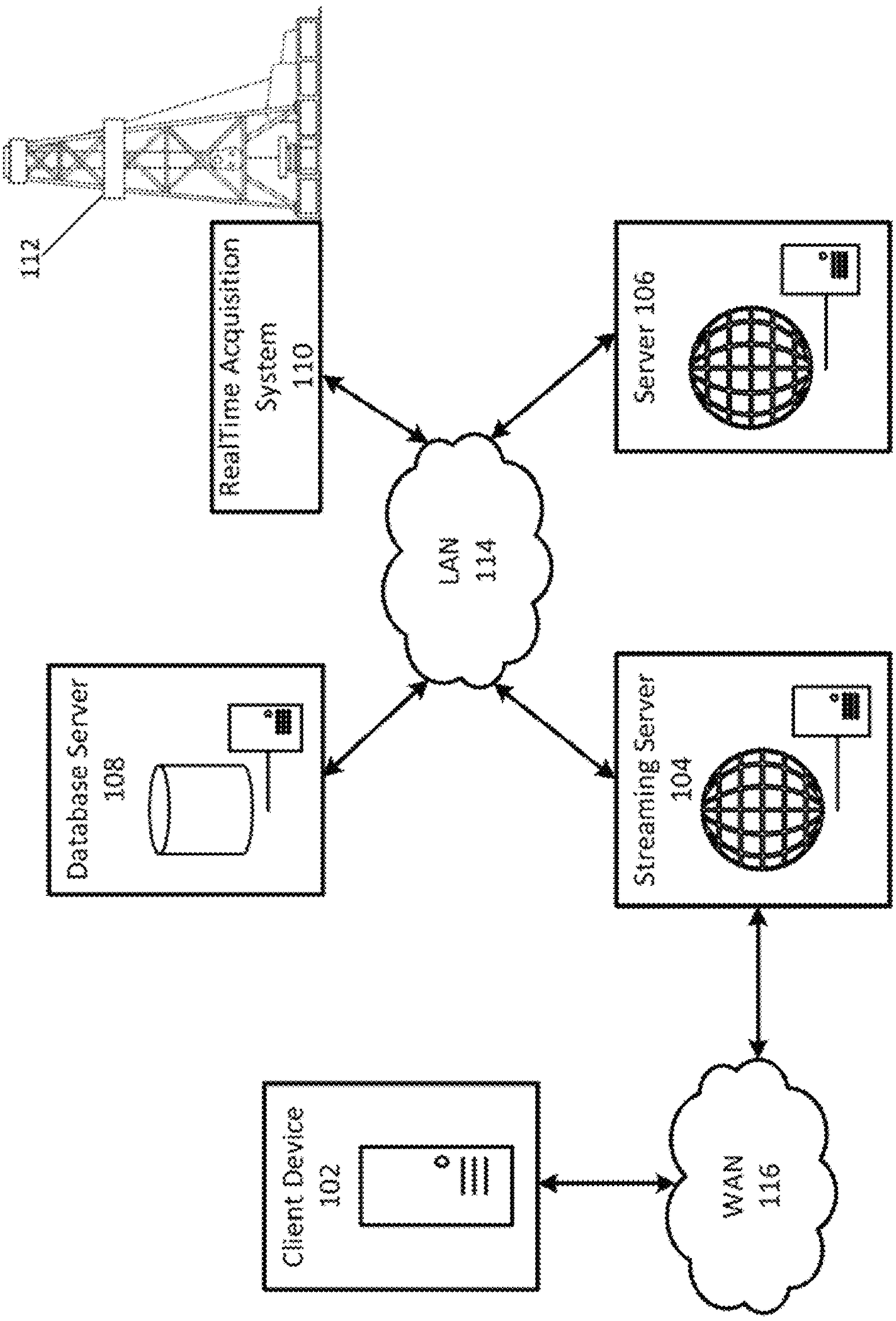

112
RealTime Acquisition System 110
Server 106
LAN 114
Database Server 108
Streaming Server 104
Client Device 102
WAN 116

FIG. 1

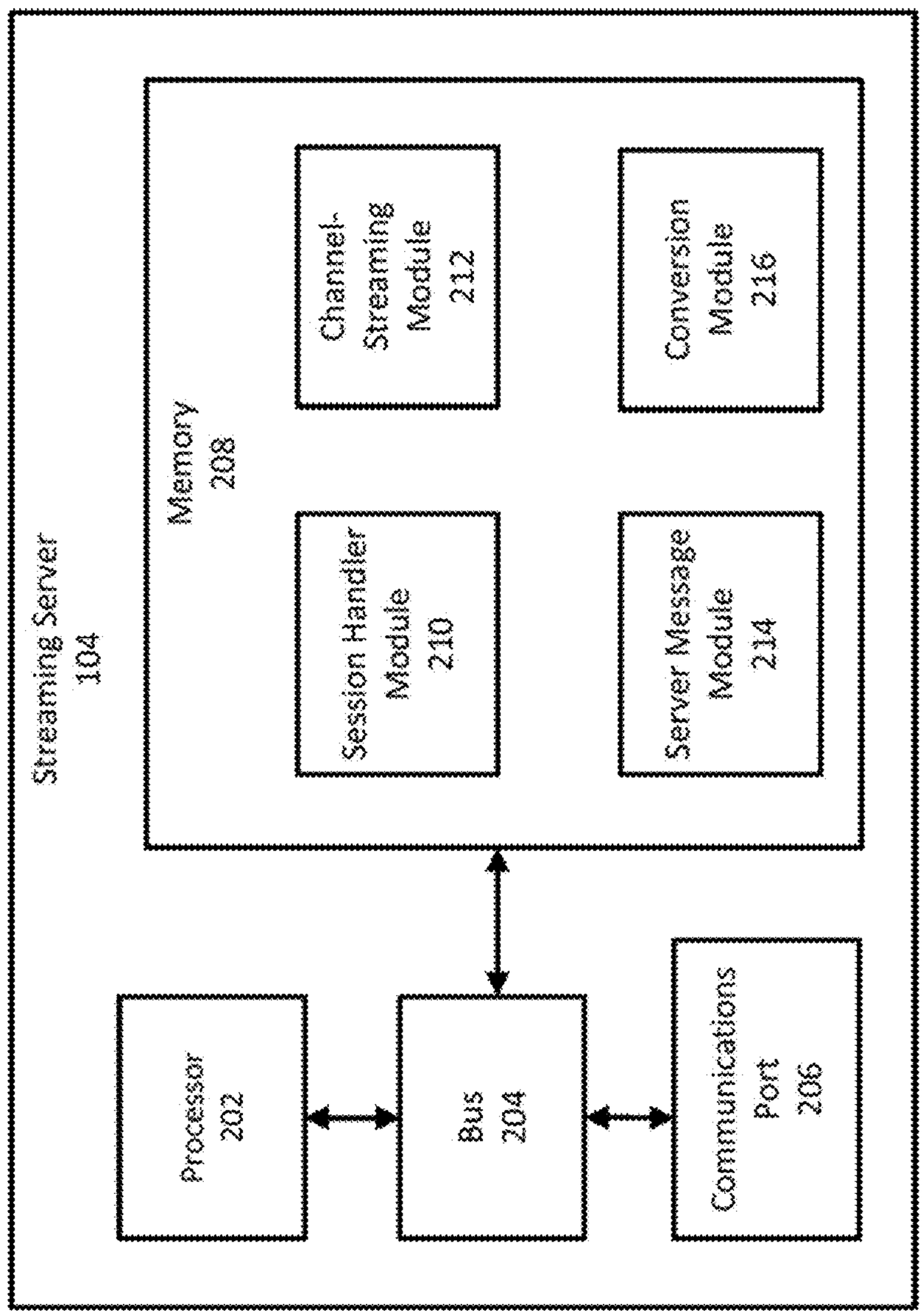

Streaming Server
104
Memory
208
Channel-Streaming Module 212
Conversion Module 216
Session Handler Module 210
Server Message Module 214
Processor 202
Bus 204
Communications Port 206

FIG. 2

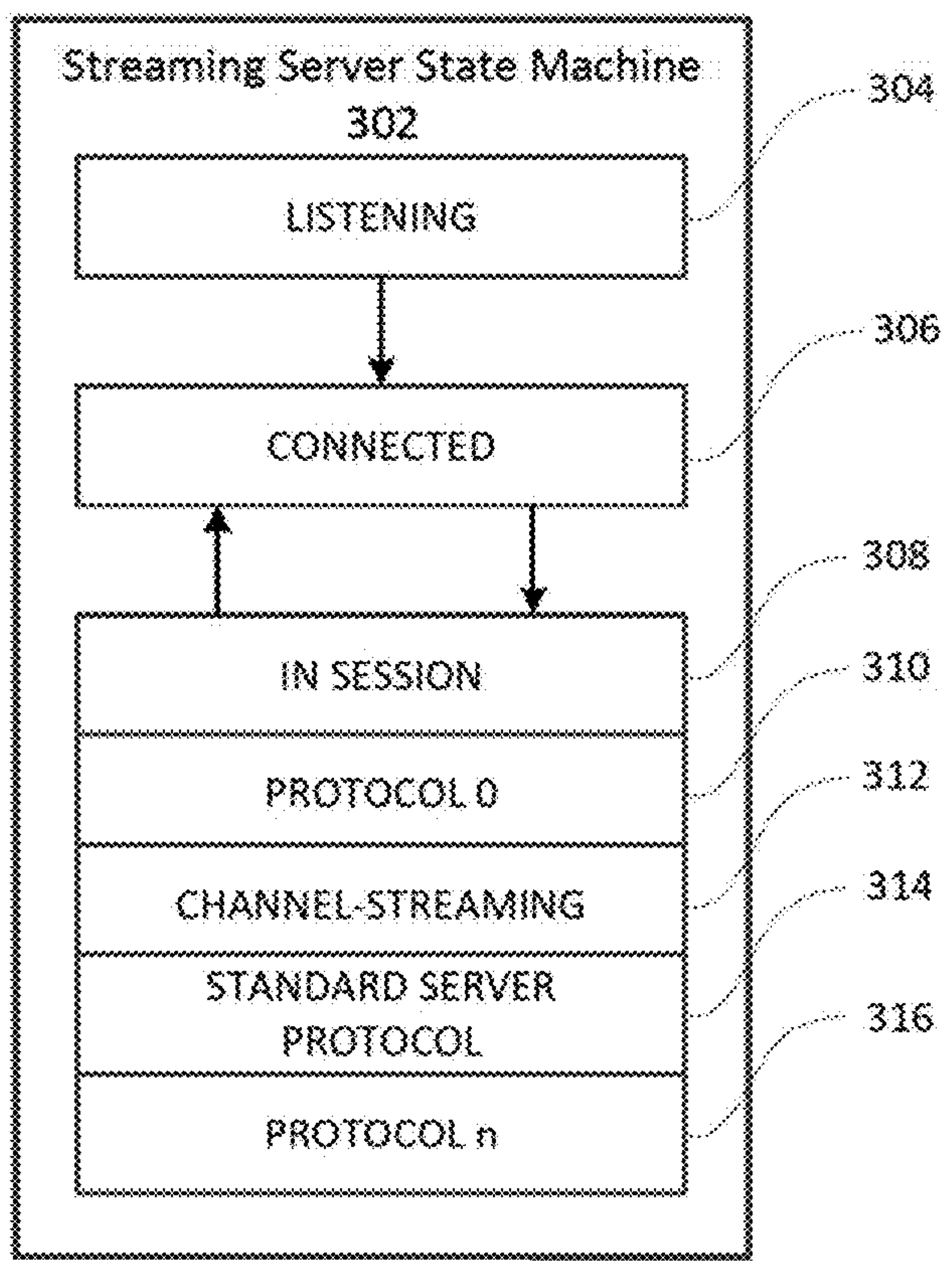

Streaming Server State Machine
302
LISTENING
304
CONNECTED
306
IN SESSION
308
PROTOCOL 0
310
CHANNEL-STREAMING
312
STANDARD SERVER PROTOCOL
314
PROTOCOL n
316

FIG. 3

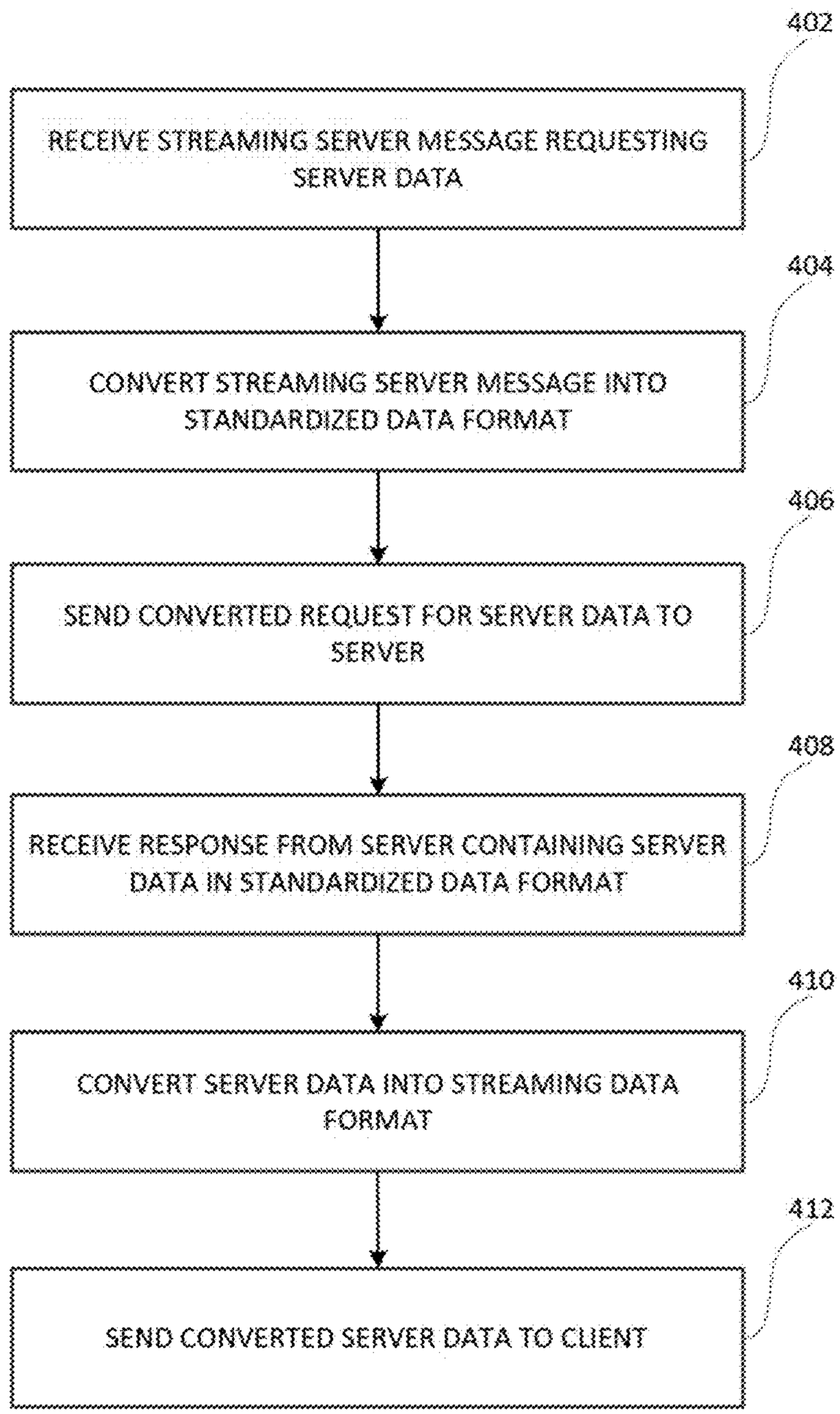

402
RECEIVE STREAMING SERVER MESSAGE REQUESTING SERVER DATA
404
CONVERT STREAMING SERVER MESSAGE INTO STANDARDIZED DATA FORMAT
406
SEND CONVERTED REQUEST FOR SERVER DATA TO SERVER
408
RECEIVE RESPONSE FROM SERVER CONTAINING SERVER DATA IN STANDARDIZED DATA FORMAT
410
CONVERT SERVER DATA INTO STREAMING DATA FORMAT
412
SEND CONVERTED SERVER DATA TO CLIENT

FIG. 4

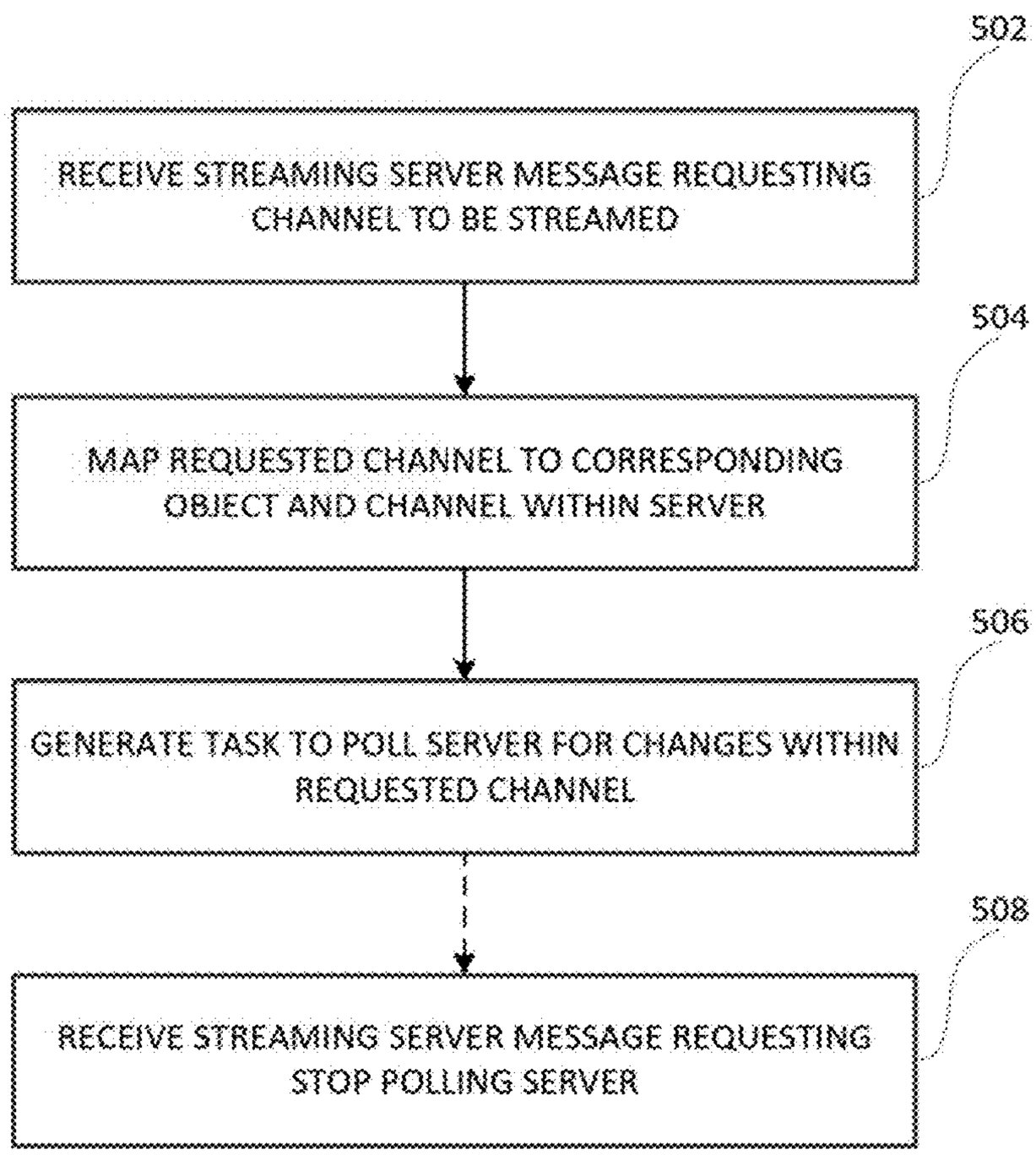

502
RECEIVE STREAMING SERVER MESSAGE REQUESTING CHANNEL TO BE STREAMED
504
MAP REQUESTED CHANNEL TO CORRESPONDING OBJECT AND CHANNEL WITHIN SERVER
506
GENERATE TASK TO POLL SERVER FOR CHANGES WITHIN REQUESTED CHANNEL
508
RECEIVE STREAMING SERVER MESSAGE REQUESTING STOP POLLING SERVER

FIG. 5

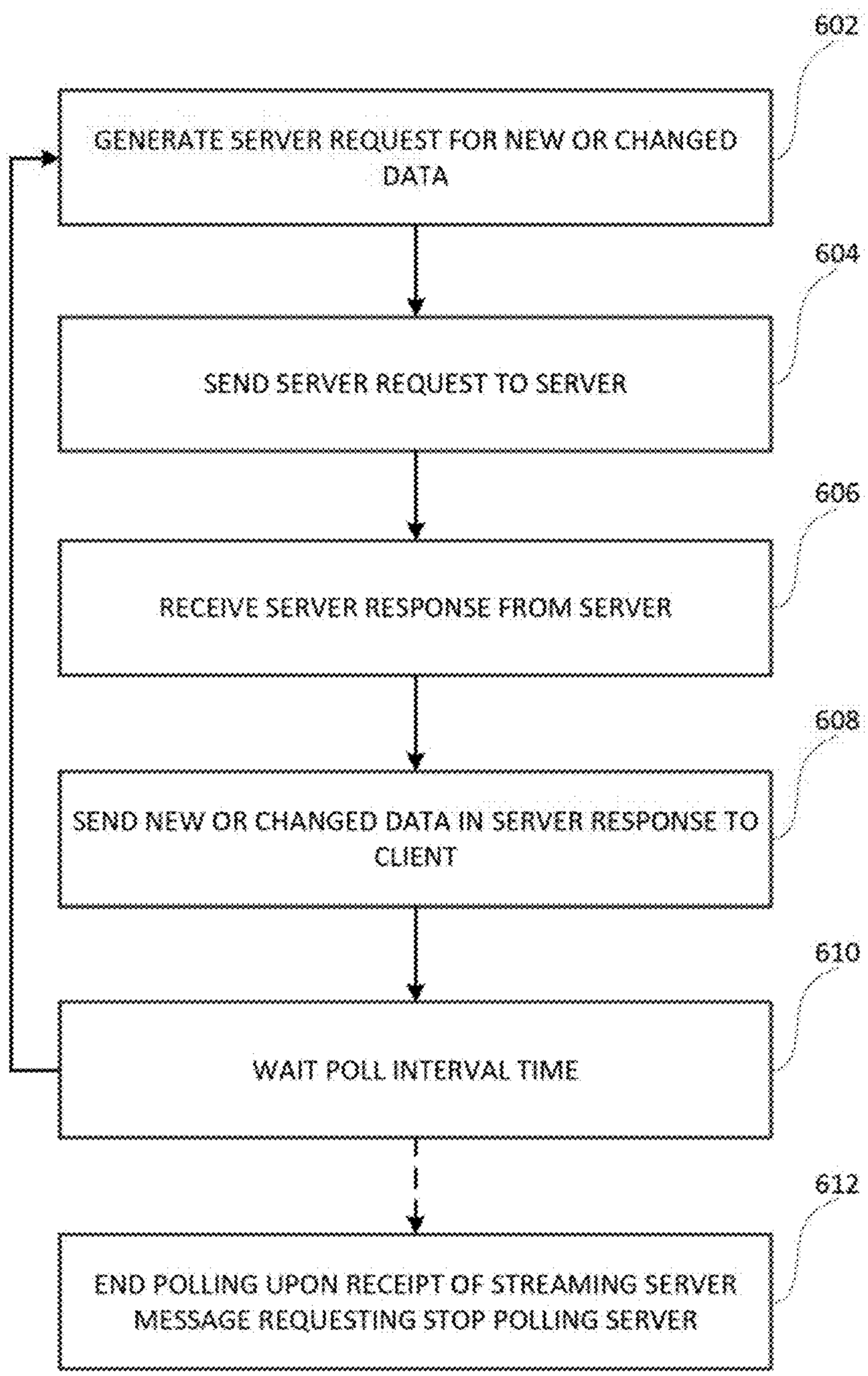

602
GENERATE SERVER REQUEST FOR NEW OR CHANGED DATA
604
SEND SERVER REQUEST TO SERVER
606
RECEIVE SERVER RESPONSE FROM SERVER
608
SEND NEW OR CHANGED DATA IN SERVER RESPONSE TO CLIENT
610
WAIT POLL INTERVAL TIME
612
END POLLING UPON RECEIPT OF STREAMING SERVER MESSAGE REQUESTING STOP POLLING SERVER

FIG. 6

USING EXISTING SERVERS IN A WELLBORE ENVIRONMENT AS DATA SOURCES FOR STREAMING SERVERS

TECHNICAL FIELD

The present disclosure relates generally to systems and methods for use in a wellbore environment. More specifically, but not by way of limitation, this disclosure relates to using existing servers as data sources for streaming servers to provide access to data about a wellbore environment.

BACKGROUND

Data from a wellbore environment can be used to monitor the environment, make decisions with respect to the environment, and plan for further wellbores, among other purposes. A data source, such as a data server, at a wellbore environment can store data obtained from various sensors and the data can be accessible by other devices. Data can be accessed remotely through a request and response protocol by which the client outputs a request for certain types of data and the data source responds to the request with the data. The device is often located great distances from the data source and the data exchange is often over a Wide Area Network (WAN) for which there may be delays in accessing the data.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic of an example of a network environment used to provide access to data about a wellbore environment according to one aspect of the disclosure.

FIG. **2** is a block diagram of an example of a streaming server usable for executing program code for using existing servers as data sources according to one aspect of the disclosure.

FIG. **3** is a state diagram of a streaming server state machine according to one aspect of the disclosure.

FIG. **4** is a flowchart of a process for using existing servers as data sources for streaming servers according to one aspect of the disclosure.

FIG. **5** is a flowchart of a process for initiating a data-streaming configuration between a streaming server and an existing server according to one aspect of the disclosure.

FIG. **6** is a flowchart of a data polling process between a streaming server and an existing server according to one aspect of the disclosure.

DETAILED DESCRIPTION

Certain aspects and features of the present disclosure relate to using an existing server as a data source for a streaming server to provide access to data about a wellbore environment. A client device can send a request across a Wide Area Network (WAN) in a streaming data format to a streaming server for accessing wellbore environment data in a database server. The streaming server, using a request and response protocol, can communicate data in a standardized format over a Local Area Network (LAN) with an existing server, which can use a different request and response protocol. The existing server can request and retrieve data relating to a wellbore environment from a database server. The streaming server can communicate the wellbore environment data, relayed by the existing server, in a streaming format with the client device. Transceiving data via the request and response protocols of an existing server over a

WAN can be time consuming, increasing the time for a client device to receive requested data. Comparatively, streaming data over the WAN via a streaming server while executing the slower existing server request and response protocols across a LAN can reduce overall latency within the communication pathway. Additionally, implementing a streaming server can provide an efficiency gain on the aggregate amount of data traversing the network: a request and response protocol typically requires state information to be sent on each request so that the server can return the proper data, requiring more bandwidth.

In certain examples, the streaming server can be an adaptor between client devices and existing servers that do not employ the latest industry standard protocols. The streaming server can bridge communication between two different protocols to allow client devices to obtain data from existing servers. The intermediary streaming server can enable continued use of existing servers without having to develop an entirely new server or refactor an existing server to communicate via the latest protocols. Without the streaming server exchanging information across various protocols, clients may consume considerable resources to restructure and rebuild data flows through existing servers to communicate with servers employing the latest protocol. Employing streaming servers using existing servers as data sources can allow data to be automatically forwarded to client devices, as opposed to a client device requesting and receiving data directly from existing servers, which can be a slower process.

In certain examples, the streaming server and the existing server can be communicatively coupled through a LAN, and the streaming server and the client device can be communicatively coupled through a WAN. Communicatively coupling a streaming server to an existing server through a LAN, as compared to a WAN, can reduce time to transfer data to a client device. The request and response protocol of the existing server, which operates less efficiently than a streaming protocol, is performed locally across a LAN and the streaming protocol is performed across a WAN. Client devices are typically connected to data sources via a WAN, which is generally slower than a LAN, out of necessity (e.g., remote or off-site location). It can be desirable in the context of overall system performance to implement more time consuming request and response protocols across a LAN, while faster streaming server protocols can be implemented across the slower, necessary WAN. In some examples, the client device may be located within the same LAN as the streaming server and existing server. In other examples, the request and response protocols may be performed across a WAN, losing the reduced latency benefit of the previous examples but retaining the ability to bridge communication protocols between the client device and the existing server. For example, the client device is communicatively coupled to the streaming server via a WAN or LAN and the streaming server is communicatively coupled to the existing server via a WAN.

In some examples, versions of Well Information Transfer Standard Markup Language (WITSML) can be employed. WITSML is a data exchange standard for specifying and exchanging data for wells and well-related operations and objects, such as drilling, logging and mud logging. WITSML can provide right-time, seamless flow of well data between operators and service companies to hasten and enhance decision making. WITSML 2.0 was developed to improve data communications within the petroleum industry. The underlying protocol of WITSML 2.0 is Energistics Transfer Protocol (ETP), which can operate at faster data

exchange speeds than prior versions of WITSML. ETP defines a streaming mechanism so that data receivers do not have to poll for data and can receive new data as soon as they are available from a data provider.

An example of a streaming server can be a server employing WITSML 2.0 using ETP. The streaming server can allow for data streaming such that data is communicated to a client device in response to the data being available, without requiring the client device to specifically requesting the data (i.e., data is automatically forward to the client device by the streaming server when the data is available from a data source).

An example of an existing server can be a WITSML 1.x server, where "1.x" represents any version of WITSML 1.0 prior to WITSML 2.0 (e.g., WITSML 1.0, WITSML 1.3.1, WITSML 1.4.1.1, etc.). A client device or streaming server can initiate a request for data via a request and response protocol to obtain information from an existing server.

In some examples, the request and response protocol used by the streaming server to communicate with an existing server can include Simple Object Access Protocols (SOAP). SOAP is a protocol specification for exchanging structured information in the implementation of web services in computer networks. SOAP employs an XML Information Set message format, and relies on application layer protocols, such as Hypertext Transfer Protocol (HTTP) or Simple Mail Transfer Protocol (SMTP), for message negotiation and transmission. SOAP can allow processes running on disparate operating systems (such as Windows and Linux) to communicate using Extensible Markup Language (XML), and can allow clients to invoke web services and receive responses independent of language and platforms. In some examples, the request and response protocol used by the existing server can be based on Remote Procedure Protocol (RPC), which is distinct from SOAP. An RPC can execute a procedure in a different address space, commonly on another computer on a shared network, which is coded as if it were a local procedure call.

In some examples, the streaming server can generate a polling task corresponding to a specific channel of the existing server. The polling task of the streaming server can transmit instructions to the existing server. The polling task can include instructions to direct the existing server to relay data within a database server to the streaming server. In response to receiving the polling task instructions via consecutive data request from the streaming server, the existing server can relay data within the database server to the streaming server as it becomes available. In response to receiving data within the database server from the existing server, the streaming server can determine if any data is new or changed.

In some examples, the streaming server can convert data received from a client device into a standardized data format. An example of a standardized data format is a WITSML 1.x format. The streaming server can convert data received from an existing server into a streaming data format. The streaming data format can be a WITSML 1.x format using ETP. Conversions between a streaming data format and a standardized data format can allow the streaming server to communicate data in an understandable format from the client device to the existing server and from the existing server to the client device.

These illustrative examples are given to introduce the reader to the general subject matter discussed here and are not intended to limit the scope of the disclosed concepts. The following sections describe various additional features and examples with reference to the drawings in which like numerals indicate like elements, and directional descriptions are used to describe the illustrative aspects but, like the illustrative aspects, should not be used to limit the present disclosure.

FIG. **1** depicts a schematic of a network environment used to provide access to data about a wellbore environment according to one example. A client device **102** can be communicatively coupled via a WAN **116** to a streaming server **104**, which can be communicatively coupled to the server **106** through a LAN **114**. A server **106** can be an "existing server" as described in any of the aforementioned examples. The client device **102**, the streaming server **104**, and the server **106** can be communicatively coupled in a network configuration as described in any of the aforementioned examples.

The server **106** can be communicatively coupled to a database server **108**, which can be communicatively coupled to a realtime acquisition system **110**. In some examples, the server **106** can be located near the database server **108**, connected to the database server via the LAN **114**. In other examples, the server **106** can be located remotely from the database server **108** and connected via a WAN. The realtime acquisition system **110** can be communicatively coupled to a well system **112**. The realtime acquisition system **110** can be located near or within the well system **112** environment, or located remotely and communicatively coupled to devices within the well system **112** via a network. Data relating to the well system **112** can be received by the realtime acquisition system **110** from the well system **112**. The database server **108** can receive data pertaining to the well system **112** from the realtime acquisition system **110**. The database server **108** can store new or update existing data in response to receiving data from the realtime acquisition system **110**. In some examples, the database server **108** can be located near the realtime acquisition system **110**, connected to the realtime acquisition system **110** via the LAN **114**. In other examples, the database server **108** can be located remotely from the realtime acquisition system **110** and connected via a WAN.

The client device **102** can issue a request and receive responses from the streaming server **104** in a streaming data format. The streaming server **104** can interpret the request from the client device **102**, convert the request and associated data into a standardized data format, and forward the request to the server **106**. The server **106** can receive the request in a standardized data format from the streaming server **104**. The request can direct the server **106** to request data from the database server **108**. The database server **108** can transmit any data to the server **106** in response to the request received from the server **106**. In response to receiving the requested data from the database server **108**, the server **106** can format the data into a standardized data format and transmit the data to the streaming server **104**. In response to receiving the data in a standardized data format from the server **106**, the streaming server **104** can convert the data into a streaming data format and transmit the data to the client device **102**. Through the previously described connections, the client device **102**, making initial requests in a format not interpretable by a standardized data format server (e.g., server **106**), can request and indirectly receive data from a database server **108** via streaming server **104** and server **106**. The streaming server **104** can act as an intermediary between the client device **102** and the server **106**, communicating to the client device **102** and the server **106** via separate communications protocols and converting data and requests into the proper data formats.

FIG. **2** is a block diagram of an example of a streaming server **104** usable for executing program code for using existing servers as data sources according to one example. The streaming server **104** can include a processor **202**, a bus **204**, a communications port **206**, and a memory **208**. In some examples, the components shown in FIG. **2** (e.g., the processor **202**, the bus **204**, the communications port **206**, and the memory **208**) can be integrated into a single structure. For example, the components can be within a single housing. In other examples, the components shown in FIG. **2** can be distributed (e.g., in separate housings) and in electrical communication with each other.

The processor **202** can execute one or more operations for implementing some examples. The processor **202** can execute instructions stored in the memory **208** to perform the operations. The processor **202** can include one processing device or multiple processing devices. Non-limiting examples of the processor **202** include a Field-Programmable Gate Array ("FPGA"), an application-specific integrated circuit ("ASIC"), a microprocessor, etc.

The processor **202** can be communicatively coupled to the memory **208** via the bus **204**. The non-volatile memory **208** may include any type of memory device that retains stored information when powered off. Non-limiting examples of the memory **208** include electrically erasable and programmable read-only memory ("EEPROM"), flash memory, or any other type of non-volatile memory. In some examples, at least some of the memory **208** can include a medium from which the processor **202** can read instructions. A computer-readable medium can include electronic, optical, magnetic, or other storage devices capable of providing the processor **202** with computer-readable instructions or other program code. Non-limiting examples of a computer-readable medium include (but are not limited to) magnetic disk(s), memory chip(s), ROM, random-access memory ("RAM"), an ASIC, a configured processor, optical storage, or any other medium from which a computer processor can read instructions. The instructions can include processor-specific instructions generated by a compiler or an interpreter from code written in any suitable computer-programming language, including, for example, C, C++, C#, etc.

The memory **208** can include program code for a session handler module **210**, a channel-streaming module **212**, a server message module **214**, and a conversion module **216**. The session handler module **210**, in response to receiving a communication request via the communications port **206**, can set up and configure communication channels in preparation for communicating data by implementing any necessary handshaking protocols. The session handler module **210** can initiate communications channels between the streaming server **104** and the client device **102** and the streaming server **104** and the server **106**. The channel-streaming module **212** can configure communications channels for streaming data between the streaming server **104** and the server **106** by transmitting start poll and stop poll requests to the server **106** via the communications port **206**. The server message module **214** can handle request and response protocols used by the streaming server **104** to communicate with the server **106**. The request and response protocol used by the streaming server **104** to communicate with the server **106** may include SOAP requests and responses. The server message module **214** can send a request to and receive a response from the server **106** via the communications port **206**. The conversion module **216** can convert requests in a streaming data format, received from the client device **102**, into requests in a standardized data format. The conversion module **216** can convert responses and data in a standardized data format, received from the server **106** in response to the request by the client device **102**, into a streaming data format.

FIG. **3** is a state diagram of a streaming server state machine **302** according to one example. At block **304**, the streaming server **104** is actively listening for devices within a network, which can be performed on a well-known URL. At block **306**, a client (e.g., client device **102**) capable of communicating via streaming messages in a streaming data format connects to the streaming server **104** and issues an open session message, which may be an Open Session ETP message. The communications channel between the client and the streaming server **104** is set up and configured by the session handler module **210**, which can implement ETP Protocol 0 in block **310** to handle initial handshaking procedures. Once connected, shown in block **308**, the client can issue messages within a given session.

Multiple protocols are defined within the streaming server state machine **302**: Protocol 0 in block **310**, channel streaming protocol in block **312**, standard server protocol in block **314**, and any other protocol delineated as protocol n in block **316**. Messages in a streaming data format received by the streaming server **104** are relayed to the channel-streaming module **212** for processing by the channel streaming protocol in block **312**. Messages in a standardized data format received by the streaming server **104** are relayed to the server message module **214** for processing by the standard server protocol in block **314**.

FIG. **4** is a flowchart describing a process for using existing servers as data sources for streaming servers according to one example.

In block **402**, the streaming server **104** receives a streaming server message requesting data from an existing server. After establishing a communications pathway via the session handler module **210**, a client (e.g., client device **102**) can send a request message to the streaming server **104** in a streaming data format, which may be a WITSML 2.0 format. The streaming server **104** can receive the request message via communications port **206**. The request message can include instructions to direct the streaming server **104** to establish a streaming communications channel with the client device **102** and to generate a polling task for continuously requesting data from an existing server (e.g., server **106**) without further request by the client device **102**.

In block **404**, the streaming server **104** converts the streaming server message received into a standardized data format. The conversion module **216** of the streaming server **104** can convert the request message received in block **402** from a streaming data format into a standardized data format, which may be a WITSML 1.x format. Converting the request message from a streaming data format into a standardized data format can allow the request message data to be transformed into a format understood by the server **106**, which uses different protocols than the client device **102**.

In block **406**, the streaming server **104** transmits the converted request message to the server **106**. The communications port **206** of the streaming server **104** can transmit the request message in a standardized data format to the server **106**. The converted request message can instruct the server **106** to receive the requested data from the database server **108**, which can then be transmitted to the streaming server **104**. The converted request message may be transmitted by the streaming server **104** using a SOAP request generated by the server message module **214**, and then received by the server **106** that can implement WITSML 1.x protocol based on a RPC. The converted request message

can include instructions for polling the server **106** generated by channel streaming module **212**.

Still referring to block **406**, a channel of the server message module **214** can be locked, such that the streaming server **104** will take no further action with respect to the server **106** that received the converted request message, until an appropriate response is received from the server **106**. Once an appropriate response is received from the server **106**, the server message module **214** can unlock that specific channel to allow for further action by the streaming server **104**. The streaming server **104** can still establish and operate additional independent communication channels controlled by the server message module **214**—the server message module **214** can establish and lock/unlock separate channels for communicating with multiple existing servers independent of the status of other channels.

In block **408**, the streaming server **104** receives a response message from the server **106** containing the requested data in a standardized data format. In response to the request message in a standardized data format transmitted by the streaming server **106**, the server **106** can communicate with the database server **108** to receive the requested data from the database server **108**, convert the received data into a standardized data format if necessary, and transmit the requested data to the streaming server **104**. This process can occur indefinitely until otherwise instructed, as further described in FIG. **6**, allowing the server **106** to continuously transmit data to the streaming server **104**. The streaming server **104** may receive the requested data using a SOAP response interpretable by the server message module **214**. Further, in block **408**, the streaming server **104** can determine if any of the data received from the server **106** is new or changed from previous versions of the data.

In block **410**, the streaming server **104** converts the response message received from the server **106** into a streaming data format. The conversion module **216** of the streaming server **104** can convert the response message received at block **408** from a standardized data format into a streaming data format, which may be a WITSML 2.0 format. Converting the request message from a streaming data format into a standardized data format can allow the response message data to be transformed into a format understood by the client device **102**, which uses different protocols than the server **106**.

In block **412**, the streaming server **104** transmits the response message in a streaming data format to the client device **102**. The response message transmitted by the streaming server **104** in a streaming data format can include any data originating from the database server **108** that the client device **102** requested in block **402**.

FIG. **5** is a flowchart describing a process for initiating a data-streaming configuration between a streaming server and an existing server according to one example.

In block **502**, the streaming server **104** receives a streaming server message requesting data from the server **106** via a specific channel. The client device **102** may request streaming of any channel that the streaming server **104** communicates as available for streaming.

In block **504**, the streaming server **104** maps the requested channel to a corresponding object and channel within the server **106**. In response to receiving the streaming server message in block **502**, the channel-streaming module **212** of the streaming server **104** can determine an appropriate object and channel of the server **106** corresponding to the data in the request message received from the client device **102**. The streaming server **104** can map a channel dedicated to the client device **102** with the determined object and channel of the server **106**. Mapping the client device **102** channel with the server **106** channel can allow the streaming server **104** to establish a streamlined communications pathway prior to transceiving requested data from the server **106** to the client device **102**. The channel of the server **106** can be mapped to specific data or data channels within the database server **108** at the instruction of the streaming server **104**, or by default prior to any communications with the streaming server **104**.

In block **506**, the streaming server **104** generates a task to poll the server **106** for changes within the requested channel. The channel-streaming module **212** can generate a task to poll the requested channel of the server **106**, which can be mapped to specific data within the database server **108**. The polling task instructions can be included in the request message in a standardized data format as described in block **406** of FIG. **4**. The polling task can be generated in response to receiving a "channelstreamingstart" message. Once generated, the polling task can be initiated allowing the streaming server **104** to continuously request real-time data from the server **106** via consecutive request messages until the streaming server **104** receives a cease polling instruction.

In block **508**, the streaming server **104** receives a streaming server message from the client device **102** requesting the streaming server **104** to stop polling the server **106**. Upon receiving a cease polling instruction from the client device **102**, the streaming server can stop generating request messages for real-time data across a channel corresponding to a specific server **106** and database server **108**. The cease polling instructions may be a "channelstreamingstop" message. A client device **102** can reinitiate the polling process by transmitting a new streaming server request message to the streaming server **104** as described in block **402**.

FIG. **6** is a flowchart describing a data polling process between a streaming server and an existing server according to one example. The following description of blocks **602**, **604**, **606**, **608**, and **610** provides further detail to the example described in block **506** of FIG. **5** for generating a polling task to poll changes within a requested channel.

In block **602**, the streaming server **104** generates a server request for new or changed data from the server **106**. As part of generating a polling task in block **506** at the request of the client device **102**, the streaming server **104** can generate a server request to transmit to the server **106**. The server request (as described in block **406** of FIG. **4**) can be in a standardized data format, which may be a WITSML 1.x format. The server request to the server **106** can include instructions allowing the server **106** to monitor data in a given channel of the database server **108**, and forward the data to the streaming server **104**.

In block **604**, the streaming server **104** transmits the server request to the server **106**. The server request may be transmitted by the streaming server **104** using a SOAP request, and then received by the server **106**, which may employ WITSML 1.x based on a RPC.

In block **606**, the streaming server **104** receives a server response from the server **106**. The polling task as depicted in FIG. **6** can halt polling processes until the server **106** returns a response to the server request transmitted in block **604**. The streaming server **104** can determine if any of the data received in the server response from the server **106** is new or changed as compared to prior versions of the data.

In block **608**, the streaming server **104** transmits new or changed data in the server response to the client device **102**. The new or changed data can be converted into a streaming data format for transmission to the client device **102**. If the streaming server **104** determines that the server response

contains no new or changed data, the streaming server **104** may not send any information to the client device **102**, and can proceed to block **610**.

In block **610**, the polling task waits for a predetermined poll interval time. The poll interval time can be any predetermined time set by a user. The poll interval time can also be any time capable of both minimizing bandwidth usage caused by repetitive server request and response messages and minimizing the time for the client device **102** to receive new or changed data upon the initial storage of the data in the database server **108**. After waiting the duration of the poll interval time, the streaming server **104** polling task can begin a new cycle of requesting data from the server **106** by reinitiating the process described in blocks **602**, **604**, **606**, **608**, and **610**, beginning in block **602**.

In block **612**, the streaming server **104** terminates polling after receiving a streaming server message from the client device **102** requesting the streaming server **104** to stop polling the server **106**. Unless otherwise instructed via a cease polling request message from the client device **102**, the streaming server **104** can indefinitely perform the looped polling operations as depicted in FIG. **6** and described in blocks **602**, **604**, **606**, **608**, and **610**.

In some aspects, systems, devices, and methods for using existing servers as data sources for streaming servers according to one or more of the following examples:

Example 1 is a system comprising: a server communicatively couplable to a database server and comprising code stored in a non-transitory computer-readable medium and executable by a processor to communicate data about a wellbore environment with the database server and a streaming server using a request and response protocol; and the streaming server comprising: a network communications port; a processor; and a non-transitory computer-readable medium including code that is executable by the processor to cause the streaming server to provide a client device with access to data in the database server as streaming data by: communicating, via the network communications port, data in a standardized data format with the server; and communicating, via the network communications port, data in a streaming data format with a client device.

Example 2 is the system of example 1, wherein the streaming server is an Energistics Transfer Protocol (ETP) server, wherein the server is a Well Information Transfer Standard Markup Language (WITSML) server.

Example 3 is the system of example 2, wherein the standardized data format is a WITSML version 1 format and the streaming data format is an ETP format such that data is able to be communicated to the client device in response to the data being available without requiring data polling by the client device.

Example 4 is the system of example 1, wherein the streaming server and the server are communicatively couplable through a Local Area Network, and the streaming server and the client device are communicatively couplable through a Wide Area Network.

Example 5 is the system of example 1, the non-transitory computer-readable medium further including code that is executable by the processor to cause the streaming server to receive data from the server by: generating a polling task corresponding to a channel of the server, the polling task including polling task instructions to direct the server to relay new or changing data within the database server to the streaming server; transmitting, via the network communications port, the polling task instructions to the server; and receiving, via the network communications port, new or changed data of the channel from the server in response to the polling task instructions.

Example 6 is the system of example 1, the non-transitory computer-readable medium further including code that is executable by the processor to cause the streaming server to provide a client device with access to data in the database server as streaming data by: converting data received from the client device into the standardized data format; and converting data received from the server into the streaming data format.

Example 7 is the system of example 1, wherein the request and response protocol usable by the streaming server to communicate data with the server includes Simple Object Access Protocols, and the request and response protocol of the server includes Remote Procedure Calls.

Example 8 is a streaming server comprising: a network communications port communicatively couplable to a server that is communicatively couplable to a database server; a processor; and a non-transitory computer-readable medium including code that is executable by the processor to cause the streaming server to provide a client device with access to data about a wellbore environment in the database server as streaming data by: communicating, via the network communications port, data in a standardized data format with the server using a request and response protocol; and communicating, via the network communications port, data in a streaming data format with a client device.

Example 9 is the streaming server of example 8, wherein the streaming server is an Energistics Transfer Protocol (ETP) server, wherein the server is a Well Information Transfer Standard Markup Language (WITSML) server.

Example 10 is the streaming server of example 9, wherein the standardized data format is a WITSML version 1 format and the streaming data format is an ETP format such that data is able to be communicated to the client device in response to the data being available without requiring data polling by the client device.

Example 11 is the streaming server of example 8, wherein the streaming server and the server are communicatively couplable through a Local Area Network, and the streaming server and the client device are communicatively couplable through a Wide Area Network.

Example 12 is the streaming server of example 8, the non-transitory computer-readable medium further including code that is executable by the processor to cause the streaming server to receive data from the server by: generating a polling task corresponding to a channel of the server, the polling task including polling task instructions to direct the server to relay new or changing data within the database server to the streaming server; transmitting, via the network communications port, the polling task instructions to the server; and receiving, via the network communications port, new or changed data of the channel from the server in response to the polling task instructions.

Example 13 is the streaming server of example 8, the non-transitory computer-readable medium further including code that is executable by the processor to cause the streaming server to provide a client device with access to data in the database server as streaming data by: converting data received from the client device into the standardized data format; and converting data received from the server into the streaming data format.

Example 14 is the streaming server of example 8, wherein the request and response protocol usable by the streaming server to communicate data with the server includes Simple

Object Access Protocols, and the request and response protocol of the server includes Remote Procedure Calls.

Example 15 is a method comprising: receiving, by a streaming server, a request from a client device to access data about a wellbore environment in a database server that is communicatively coupled to a server that is communicatively coupled to the streaming server; communicating, via the streaming server, data in a standardized data format with the server using a request and response protocol; and communicating, via the streaming server and in a streaming data format, data from the database server with a client device.

Example 16 is the method of example 15, wherein the streaming server is an Energistics Transfer Protocol (ETP) server, wherein the server is a Well Information Transfer Standard Markup Language (WITSML) server.

Example 17 is the method of example 16, wherein the standardized data format is a WITSML version 1 format and the streaming data format is an ETP format such that data is communicated to the client device in response to the data being available without requiring data polling by the client device.

Example 18 is the method of example 15, wherein the streaming server and the server are communicatively coupled through a Local Area Network, and the streaming server and the client device are communicatively coupled through a Wide Area Network.

Example 19 is the method of example 15, further comprising: converting data received from the client device into the standardized data format; generating, via the streaming server, a polling task corresponding to a channel of the server in response to receiving data from the client device, the polling task including polling task instructions to direct the server to relay new or changing data within the database server to the streaming server; transmitting, via the network communications port, the polling task instructions to the server in the standardized data format; receiving, via the network communications port, new or changed data of the channel from the server in response to the polling task instructions; and converting data received from the server into the streaming data format.

Example 20 is the method of example 15, wherein the request and response protocol usable by the streaming server to communicate data with the server includes Simple Object Access Protocols, and the request and response protocol of the server includes Remote Procedure Calls.

Example 21 is a streaming server comprising: a network communications port communicatively couplable to a server that is communicatively couplable to a database server; a processor; and a non-transitory computer-readable medium including code that is executable by the processor to cause the streaming server to provide a client device with access to data about a wellbore environment in the database server as streaming data by: communicating, via the network communications port, data in a standardized data format with the server using a request and response protocol; and communicating, via the network communications port, data in a streaming data format with a client device.

Example 22 is the streaming server of example 21, wherein the streaming server is an Energistics Transfer Protocol (ETP) server, wherein the server is a Well Information Transfer Standard Markup Language (WITSML) server.

Example 23 is the streaming server of any of example(s) 21 to 22, wherein the standardized data format is a WITSML version 1 format and the streaming data format is an ETP format such that data is able to be communicated to the client device in response to the data being available without requiring data polling by the client device.

Example 24 is the streaming server of any of example(s) 21 to 23, wherein the streaming server and the server are communicatively couplable through a Local Area Network, and the streaming server and the client device are communicatively couplable through a Wide Area Network.

Example 25 is the streaming server of any of example(s) 21 to 24, the non-transitory computer-readable medium further including code that is executable by the processor to cause the streaming server to receive data from the server by: generating a polling task corresponding to a channel of the server, the polling task including polling task instructions to direct the server to relay new or changing data within the database server to the streaming server; transmitting, via the network communications port, the polling task instructions to the server; and receiving, via the network communications port, new or changed data of the channel from the server in response to the polling task instructions.

Example 26 is the streaming server of any of example(s) 21 to 25, the non-transitory computer-readable medium further including code that is executable by the processor to cause the streaming server to provide a client device with access to data in the database server as streaming data by: converting data received from the client device into the standardized data format; and converting data received from the server into the streaming data format.

Example 27 is the streaming server of any of example(s) 21 to 26, wherein the request and response protocol usable by the streaming server to communicate data with the server includes Simple Object Access Protocols, and the request and response protocol of the server includes Remote Procedure Calls.

Example 28 is the streaming server of any of example(s) 21 to 27, wherein the streaming server is in a system that comprises: the server communicatively couplable to the database server and comprising code stored in a non-transitory computer-readable medium and executable by a processor to communicate data about the wellbore environment with the database server and the streaming server using a request and response protocol.

Example 29 is a method comprising: receiving, by a streaming server, a request from a client device to access data about a wellbore environment in a database server that is communicatively coupled to a server that is communicatively coupled to the streaming server; communicating, via the streaming server, data in a standardized data format with the server using a request and response protocol; and communicating, via the streaming server and in a streaming data format, data from the database server with a client device.

Example 30 is the method of example 29, wherein the streaming server is an Energistics Transfer Protocol (ETP) server, wherein the server is a Well Information Transfer Standard Markup Language (WITSML) server.

Example 31 is the method of any of example(s) 29 to 30, wherein the standardized data format is a WITSML version 1 format and the streaming data format is an ETP format such that data is communicated to the client device in response to the data being available without requiring data polling by the client device.

Example 32 is the method of any of example(s) 29 to 31, wherein the streaming server and the server are communicatively coupled through a Local Area Network, and the streaming server and the client device are communicatively coupled through a Wide Area Network.

Example 33 is the method of any of example(s) 29 to 32, further comprising: generating, via the streaming server, a

polling task corresponding to a channel of the server, the polling task including polling task instructions to direct the server to relay new or changing data within the database server to the streaming server; transmitting, via the network communications port, the polling task instructions to the server; and receiving, via the network communications port, new or changed data of the channel from the server in response to the polling task instructions.

Example 34 is the method of any of example(s) 29 to 33, further comprising: converting data received from the client device into the standardized data format; and converting data received from the server into the streaming data format.

Example 35 is the method of any of example(s) 29 to 34, wherein the request and response protocol usable by the streaming server to communicate data with the server includes Simple Object Access Protocols, and the request and response protocol of the server includes Remote Procedure Calls.

The foregoing description of certain examples, including illustrated examples, has been presented only for the purpose of illustration and description and is not intended to be exhaustive or to limit the disclosure to the precise forms disclosed. Numerous modifications, adaptations, and uses thereof will be apparent to those skilled in the art without departing from the scope of the disclosure.

What is claimed is:

1. A system comprising:

a first server communicatively couplable to a database server and comprising code stored in a non-transitory computer-readable medium and executable by a processor to communicate data about a wellbore environment with the database server and a streaming server that is an Energistics Transfer Protocol (ETP) server using a request and response protocol; and

the streaming server comprising:

a network communications port;

a processor; and

a non-transitory computer-readable medium including code that is executable by the processor to cause the streaming server to provide a client device with access to data in the database server as streaming data by:

communicating, via the network communications port and via a local area network (LAN), data in a standardized data format with the first server; and

communicating, via the network communications port and via a wide area network (WAN), data in a streaming data format with a client device, the streaming data format being an ETP format such that data is able to be communicated to the client device in response to the data being available without requiring data polling by the client device.

2. The system of claim **1**, wherein the first server is a Well Information Transfer Standard Markup Language (WITSML) server.

3. The system of claim **2**, wherein the standardized data format is a WITSML version 1 format.

4. The system of claim **1**, the non-transitory computer-readable medium further including code that is executable by the processor to cause the streaming server to receive data from the first server by:

generating a polling task corresponding to a channel of the first server, the polling task including polling task instructions to direct the first server to relay new or changing data within the database server to the streaming server;

transmitting, via the network communications port, the polling task instructions to the first server; and

receiving, via the network communications port, new or changed data of the channel from the first server in response to the polling task instructions.

5. The system of claim **1**, the non-transitory computer-readable medium further including code that is executable by the processor to cause the streaming server to provide a client device with access to data in the database server as streaming data by:

converting data received from the client device into the standardized data format; and

converting data received from the first server into the streaming data format.

6. The system of claim **1**, wherein the request and response protocol usable by the streaming server to communicate data with the first server includes Simple Object Access Protocols, and the request and response protocol of the first server includes Remote Procedure Calls.

7. A streaming server comprising:

a network communications port communicatively couplable to a first server that is communicatively couplable to a database server;

a processor; and

a non-transitory computer-readable medium including code that is executable by the processor to cause the streaming server that is an Energistics Transfer Protocol (ETP) server to provide a client device with access to data about a wellbore environment in the database server as streaming data by:

communicating, via the network communications port and via a local area network (LAN), data in a standardized data format with the first server using a request and response protocol; and

communicating, via the network communications port and via a wide area network (WAN), data in a streaming data format with a client device, the streaming data format being an ETP format such that data is able to be communicated to the client device in response to the data being available without requiring data polling by the client device.

8. The streaming server of claim **7**, wherein the first server is a Well Information Transfer Standard Markup Language (WITSML) server.

9. The streaming server of claim **8**, wherein the standardized data format is a WITSML version 1 format.

10. The streaming server of claim **7**, the non-transitory computer-readable medium further including code that is executable by the processor to cause the streaming server to receive data from the first server by:

generating a polling task corresponding to a channel of the first server, the polling task including polling task instructions to direct the first server to relay new or changing data within the database server to the streaming server;

transmitting, via the network communications port, the polling task instructions to the first server; and

receiving, via the network communications port, new or changed data of the channel from the first server in response to the polling task instructions.

11. The streaming server of claim **7**, the non-transitory computer-readable medium further including code that is executable by the processor to cause the streaming server to provide a client device with access to data in the database server as streaming data by:

converting data received from the client device into the standardized data format; and

converting data received from the first server into the streaming data format.

12. The streaming server of claim **7**, wherein the request and response protocol usable by the streaming server to communicate data with the first server includes Simple Object Access Protocols, and the request and response protocol of the first server includes Remote Procedure Calls.

13. A method comprising:

receiving, by a streaming server that is an Energistics Transfer Protocol (ETP) server, a request from a client device to access data about a wellbore environment in a database server that is communicatively coupled to a first server that is communicatively coupled to the streaming server;

communicating, via the streaming server over a local area network (LAN), data in a standardized data format with the first server using a request and response protocol; and

communicating, via the streaming server over a wide area network (WAN), and in a streaming data format, data from the database server with a client device, the streaming data format being an ETP format such that data is communicated to the client device in response to the data being available without requiring data polling by the client device.

14. The method of claim **13**, wherein the first server is a Well Information Transfer Standard Markup Language (WITSML) server.

15. The method of claim **14**, wherein the standardized data format is a WITSML version 1 format.

16. The method of claim **13**, further comprising:

converting data received from the client device into the standardized data format;

generating, via the streaming server, a polling task corresponding to a channel of the first server in response to receiving data from the client device, the polling task including polling task instructions to direct the first server to relay new or changing data within the database server to the streaming server;

transmitting, via a network communications port, the polling task instructions to the first server in the standardized data format;

receiving, via the network communications port, new or changed data of the channel from the first server in response to the polling task instructions; and

converting data received from the first server into the streaming data format.

17. The method of claim **13**, wherein the request and response protocol usable by the streaming server to communicate data with the first server includes Simple Object Access Protocols, and the request and response protocol of the first server includes Remote Procedure Calls.

18. The system of claim **4**, the non-transitory computer-readable medium further including code that is executable by the processor to cause the streaming server to:

transmit a request for the data in the standardized format to the first server via the channel; and

subsequent to transmitting the request, lock the channel until a response to the request is received from the first server.

19. The streaming server of claim **10**, the non-transitory computer-readable medium further including code that is executable by the processor to cause the streaming server to:

transmit a request for the data in the standardized format to the first server via the channel; and

subsequent to transmitting the request, lock the channel until a response to the request is received from the first server.

20. The method of claim **16**, further comprising:

transmitting a request for the data in the standardized format to the first server via the channel; and

subsequent to transmitting the request, locking the channel until a response to the request is received from the first server.

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